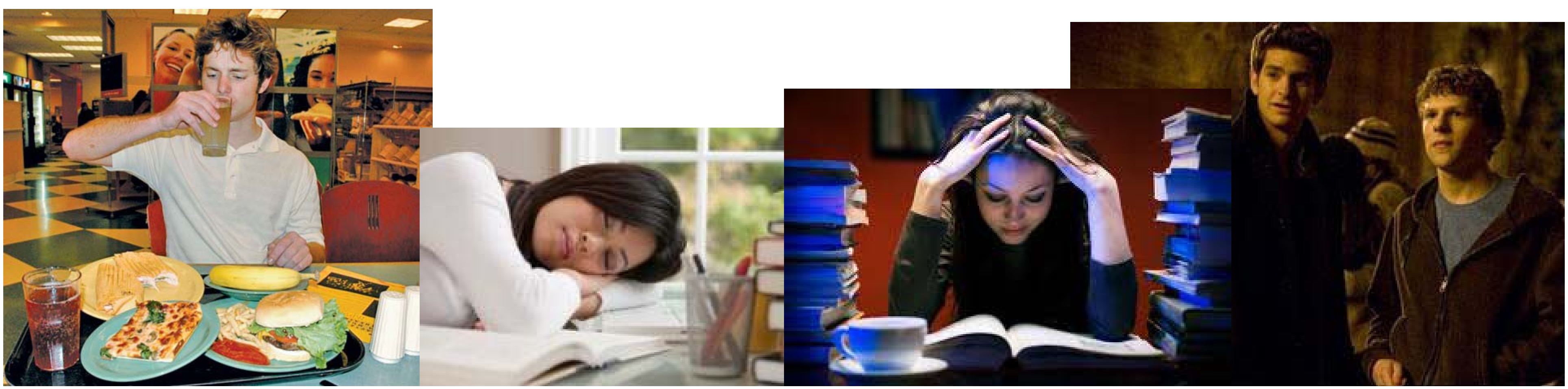
# The daily behavior of early college students

Eat, Drink, Sleep, Study, Play…



# Why do we (animals) sleep?

**Mammals, birds, fishes, insects… even a millimeter-long worm called a nematode sleeps**

# What do we do during sleep?

1. Sensory perception reduces (eyes close).
2. Muscles (motor function) relax.
3. Dream!

# Why do we sleep?

# Hypotheses

1. The first is that sleeping allows the body to repair cells damaged by metabolic byproducts.
2. Sleep helps replenish fuel, which is burned while awake. one possible fuel is ATP.
3. Sleep might also be a time for your brain to do a little housekeeping.
4. Your brain might be replaying the events of the day, reinforcing memory and learning. boosts or consolidates memories, to reorganize and restructure memories so that people retain the most salient of those.

# Why do we sleep?

## Hypotheses 4

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When juvenile songbirds learn their song during the day; they rehearse the song they learned during sleep . (without producing sounds).

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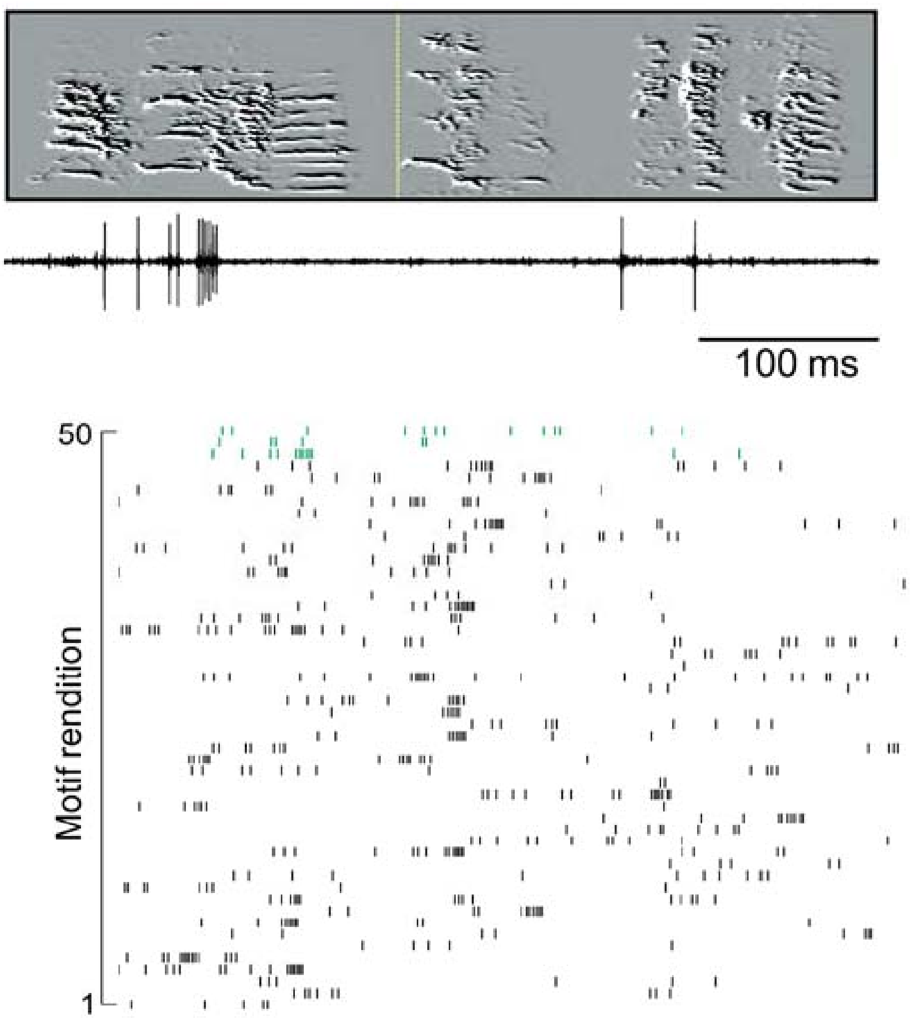


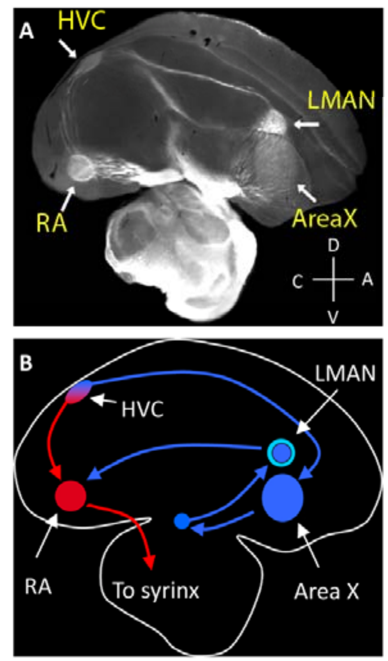




Figure 1. (A) Dark field image of a brain section (saggital) through several song nuclei. (B) Circuit diagram of song system.

# Sleep helps your study

(a learning strategy you can try, based on a neuroscience hypothesis of sleep)

Study- work hard, think, memorize…

Then have a good sleep

- neurons/ synapses connect; consolidate/ reorganize memory.

Wake up- rehearse (consciously organize consolidated memory) → creative!

# Foraging behavior

# Food caching by Squirrels

# Food caching in birds

Common in Corvidae (crows, jays)
and Paridae (tits, chickadees)

# Food caching by Clark's Nutcracker

Cache ~98,000 seeds per season

Remarkable long-term spatial memory;
relocate caches of seeds with remarkable accuracy,
often nine months later, and even when the cache sites are buried under up to a meter (3 ft) of snow

# Food caching by scrub jays

Effects of experience and social context on prospective caching strategies by scrub jays

This is a good example about how you write your project and design experiments

1. Observations: Scrub jays remember where conspecifics have cached, pilfering them when given the opportunity.

2. Hypothesis 1: Scrub jays may adjust their own caching strategies to minimize potential pilfering.
(anti-pilfering strategy)

3. Predictions

Jays would be more likely to re-cache more of any uneaten food, and specifically in new sites unknown to an observer, but only if they had been watched during the caching trial.

## 4. Experimental designs:

Scrub jays were allowed to cache either in private (when the other bird's view was obscured) or while a conspecific was watching, and then recover their caches in private.

## 5. Results

birds re-cached significantly more items during recovery when they had been observed during caching.

**Table 1 Behaviour of the observer + pilferer birds during observed and in private caching treatments**

| | Caching treatment | | Wilcoxon pairs test | | |
|---|---|---|---|---|---|
| Behaviour | Observed | In private | *n* | *Z* | *P* |
| No. cached | | | | | |
| Davis | 8.19 ± 1.56 | 4.71 ± 0.81 | 7 | 2.37 | <0.05 |
| Cambridge | 10.48 ± 3.43 | 9.10 ± 3.05 | 7 | 0.51 | >0.5 |
| No. recovered | | | | | |
| Davis | 4.61 ± 0.93 | 3.95 ± 0.84 | 7 | 0.85 | >0.1 |
| Cambridge | 5.38 ± 1.56 | 4.19 ± 1.10 | 7 | 0.08 | >0.5 |
| Proportion recovered | | | | | |
| Davis | 0.71 ± 0.06 | 0.57 ± 0.07 | 7 | 2.03 | <0.05 |
| Cambridge | 0.56 ± 0.08 | 0.70 ± 0.09 | 7 | 1.69 | >0.05 |
| Recovery accuracy* | | | | | |
| Davis | 2.21 ± 0.46 | 3.21 ± 1.01 | 7 | 1.15 | >0.1 |
| Cambridge | 3.07 ± 0.92 | 1.52 ± 0.24 | 7 | 1.36 | >0.1 |
| No. re-cached | | | | | |
| Davis | 2.19 ± 0.68 | 0.57 ± 0.32 | 7 | 2.20 | <0.05 |
| Cambridge | 2.74 ± 1.01 | 0.36 ± 0.19 | 7 | 2.20 | <0.05 |
| Proportion re-cached | | | | | |
| Davis | 0.44 ± 0.20 | 0.08 ± 0.03 | 7 | 2.20 | <0.05 |
| Cambridge | 0.28 ± 0.07 | 0.08 ± 0.04 | 7 | 2.20 | <0.05 |

# 5. Result II

Re-caching was predominately in the new sites, rather than old sites.

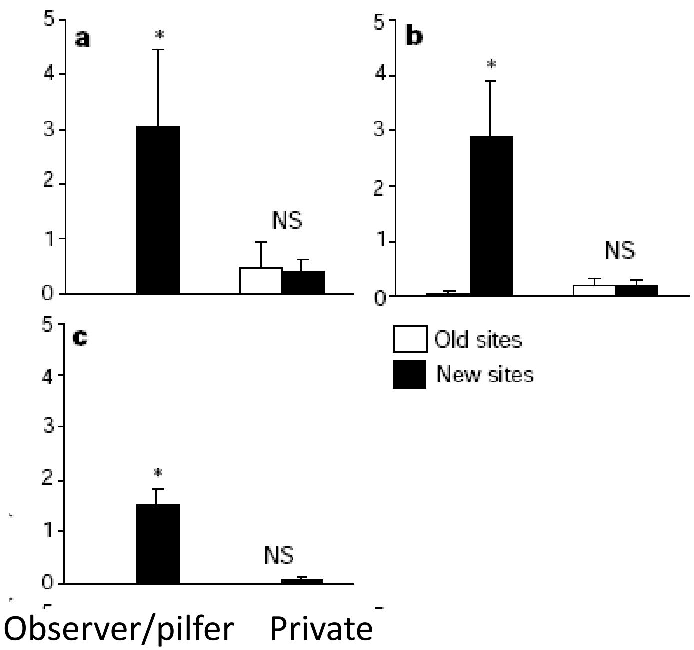



**Figure 1** Mean (+ s.e.m.) number of worms re-cached by the three groups. **a**, The observer + pilferer group in Davis re-cached significantly more in the new sites during the observed caching treatment ($n = 7$, $Z = 2.20$, $P < 0.05$), but failed to discriminate between new and old sites during the in private caching treatment ($n = 7$, $Z = 0$, $P = 1.0$). **b**, The observer + pilferer group in Cambridge also re-cached significantly more in new sites when observed during caching ($n = 7$, $Z = 2.20$, $P < 0.05$), but again did not discriminate between re-caching in old or new sites during the in private caching treatment (no statistical comparison possible). **c**, The observer + pilferer group also selectively re-cached food in new sites in the observed tray ($n = 7$, $Z = 2.37$, $P < 0.05$), but did not discriminate between old and new sites in the in private tray during the interleaved caching trials (no statistical comparison possible). **d**, The observer group did

6. Conclusion: the results are consistent with the predictions, thus they support the Hypothesis I that the scrub jay has anti-pilfering strategy depending on social contexts (presence of conspecifics)

1. Observations: Scrub jays adjust their own caching strategies to minimize potential pilfering. (anti-pilfering strategy)

2. Hypothesis II: Anti-pilfering strategy may require the experience of being a pilferer in the past.

3. Predictions:

Pilfer (had experience of pilfering) would re-cache while a conspecific was watching, and then recover their caches in private. Observer (no experience of pilfering) would not re-cache to new sites.

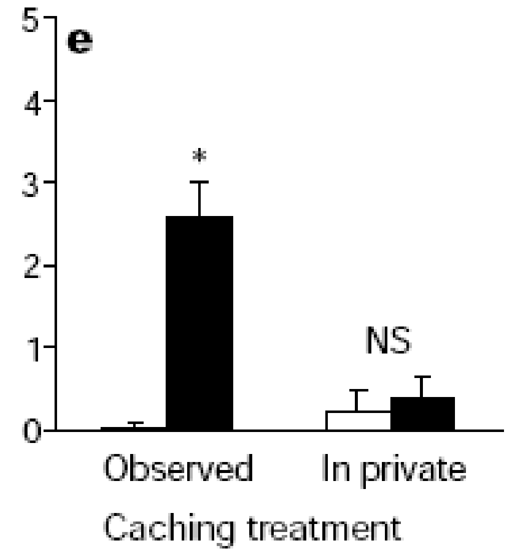
## 4. Experimental designs

Birds in the pilferer group had the opportunity to listen to, but not observe, another bird caching, and were then allowed to pilfer those caches. As all the birds had received extensive caching experience, they readily searched for caches even when they had not seen the storer hide food.

These birds do not have the opportunity to observe conspecifics caching in these experiments, but have the experience of pilfering.

5. Result

pilferer group re-cached more items during recovery if they had been observed during caching, and predominantly in new sites.




6. Conclusion: the results are consistent with the predictions, thus they support the hypothesis that jays need experience of being a pilfering to know when to re-cache.

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# Summary

1. scrub jay can use anti-pilfering strategy depending on social contexts (presence of conspecifics)

2. Jays remember not only whether they were being observed, but can also recall the specific tray in which they cached while being watched,

3. Jays need experience of being a pilferer to know when to re-cache. Not require experience of observing a con- specific hide food.

# Implications:

1. Jays remember the social context of specific past events, and adjust their present behavior to avoid potentially detrimental consequences in the future (pilfering).

2. The jays seem to have transferred their previous experience of being a pilferer to the current situation in which their own caches might be stolen.

3. Episodic memory and future planning?

# Episodic memory

Episodic memory is a category of long-term memory that involves the recollection of specific events, situations and experiences.

Your first day of school, your first kiss, attending your brother's graduation are examples of episodic memories.

In addition to your overall recall of the event itself, it also involves your memory of the location and time that the event occurred.

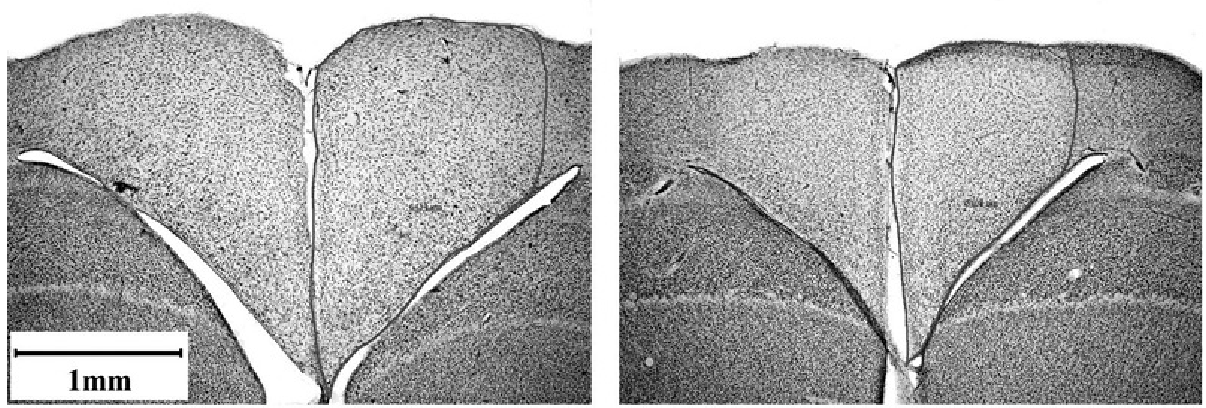
This article a good example about how you write your project and design experiments to test hypothesis.

1. Observation
2. Questions
3. Hypotheses
4. Predictions
5. Experimental designs to test hypotheses
6. Results
7. Falsify or approve hypotheses
8. Conclusion

# Food caching and hippocampal size

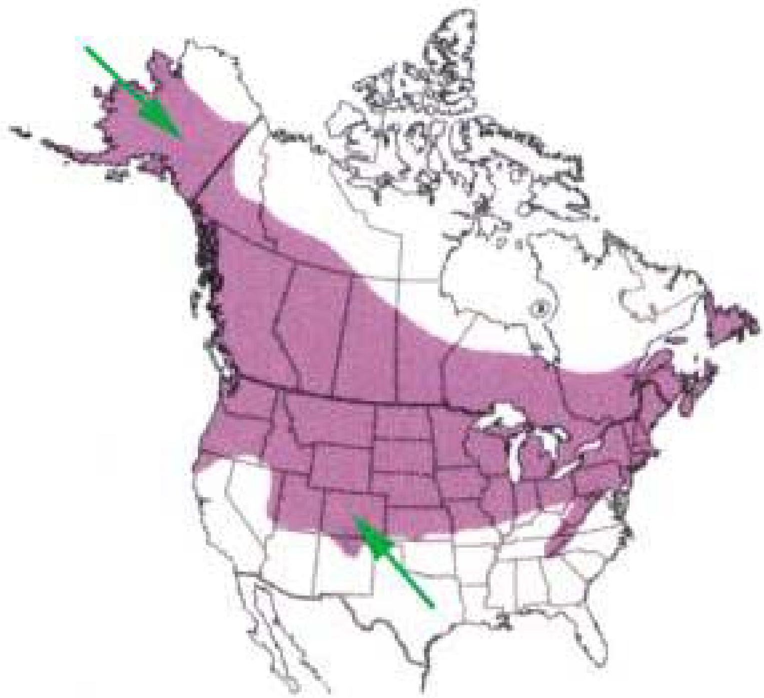
1. Compare different species of Corvidae and Paridae
   The more food-storing behavior seen in a species
   → the greater the hippocampal volume.

(function of hippocampus in birds: spatial memory)




Wild Bird  Captive Bird

**Differences in memory and the hippocampus between northern and southern populations of a food-storing species, the black-capped chickadee.**



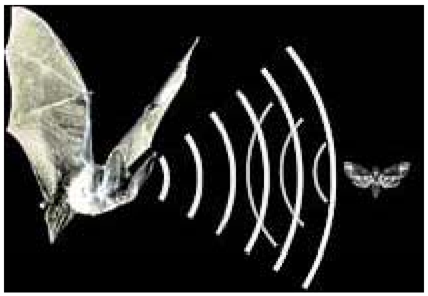
Black-capped chickadees living in Alaska cache more food, are more efficient at cache recovery, perform more accurately on spatial memory tasks and have larger hippocampal volumes than black-capped chickadees that live in Colorado.

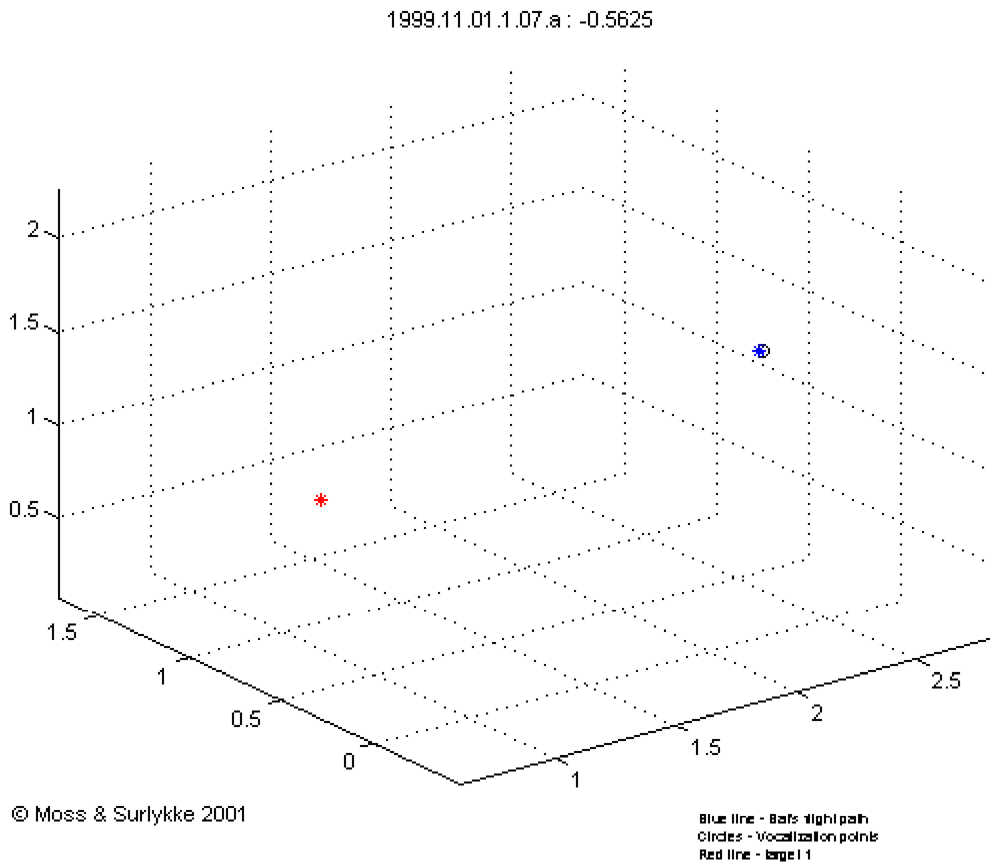
Bat: use echolocation to forage

Echolocation: emit calls out to the environment and listen to the echoes of those calls that return from various objects in the environment.

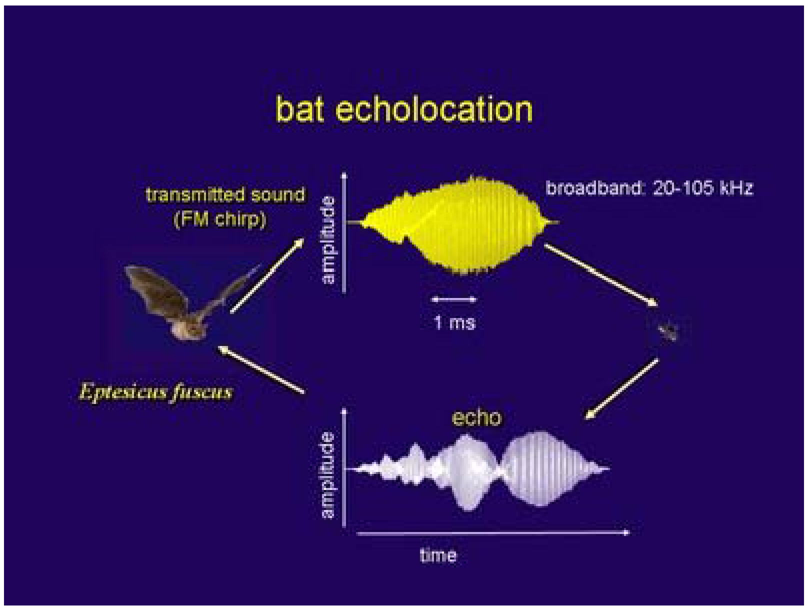
They use these echoes to locate, range, and identify the objects.

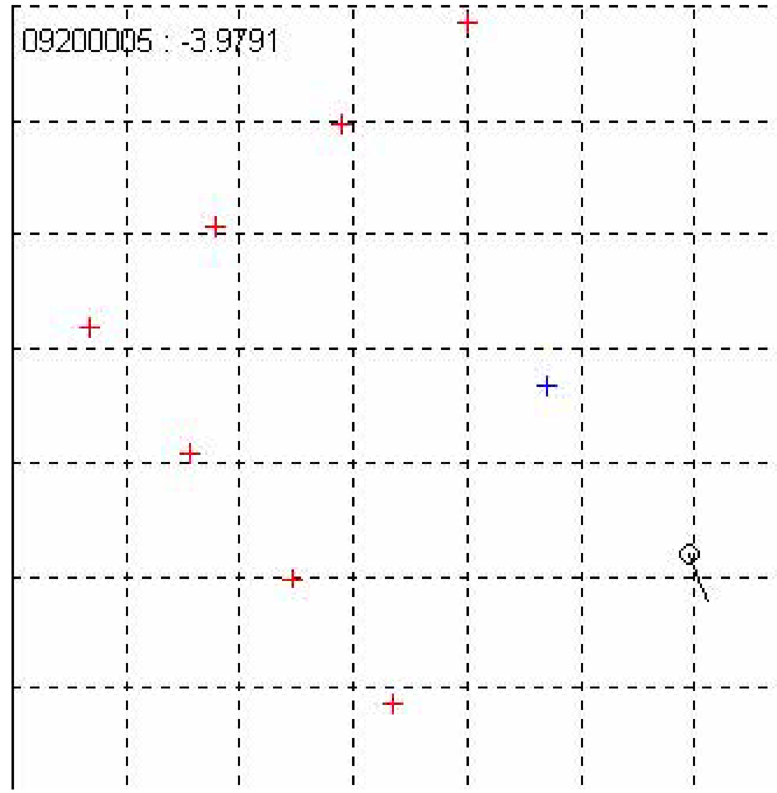
Ultrasonic : 14,000 to well over 200,000 Hz, why so high freq? and loud 50-120 dB.






Dr. Cynthia Moss, Univ. of Maryland


bat echolocation
transmitted sound
(FM chirp)
broadband: 20-105 kHz
amplitude
1 ms
Eptesicus fuscus
echo
amplitude
time


09200005 : -3.9791

# Echolocation in bats

Innate response to water surface

# Honey bees: getting help from companions

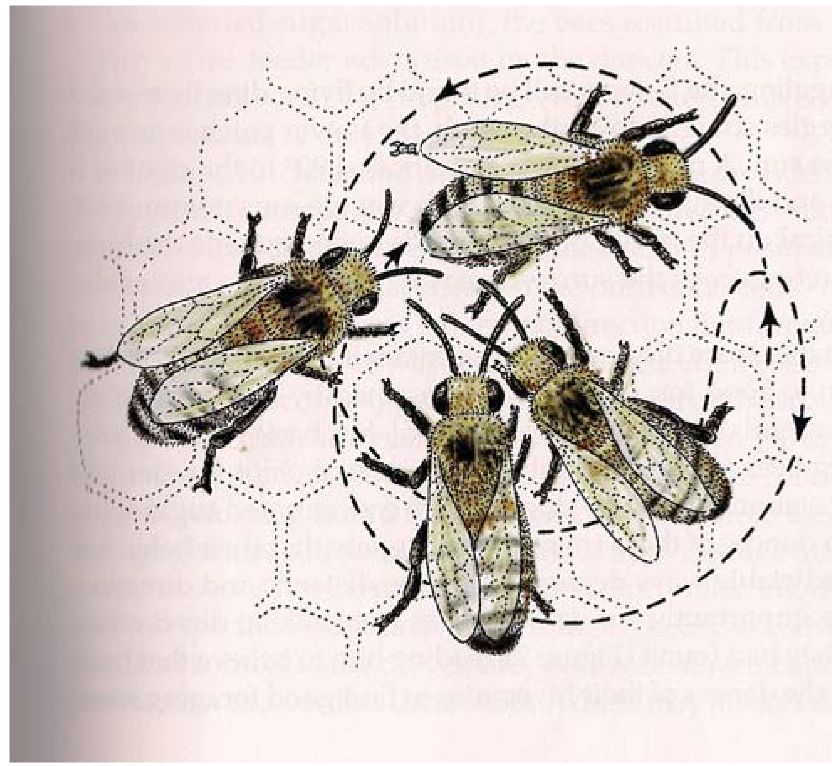
Foraging worker bees perform dance when they return to the hive after having found a good source of pollen or nectar.

Dances contain a lot of information abut the location of the food source.

# Honey bee dance

1.Round dance

food source is <50 meters

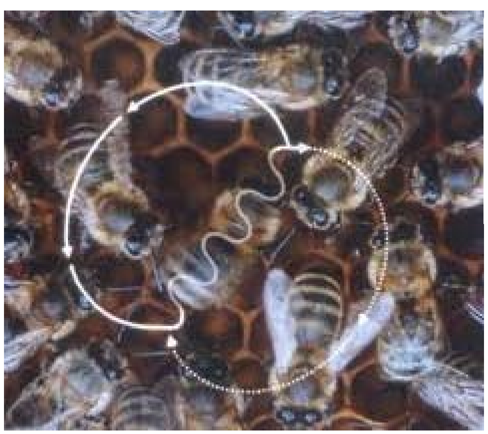


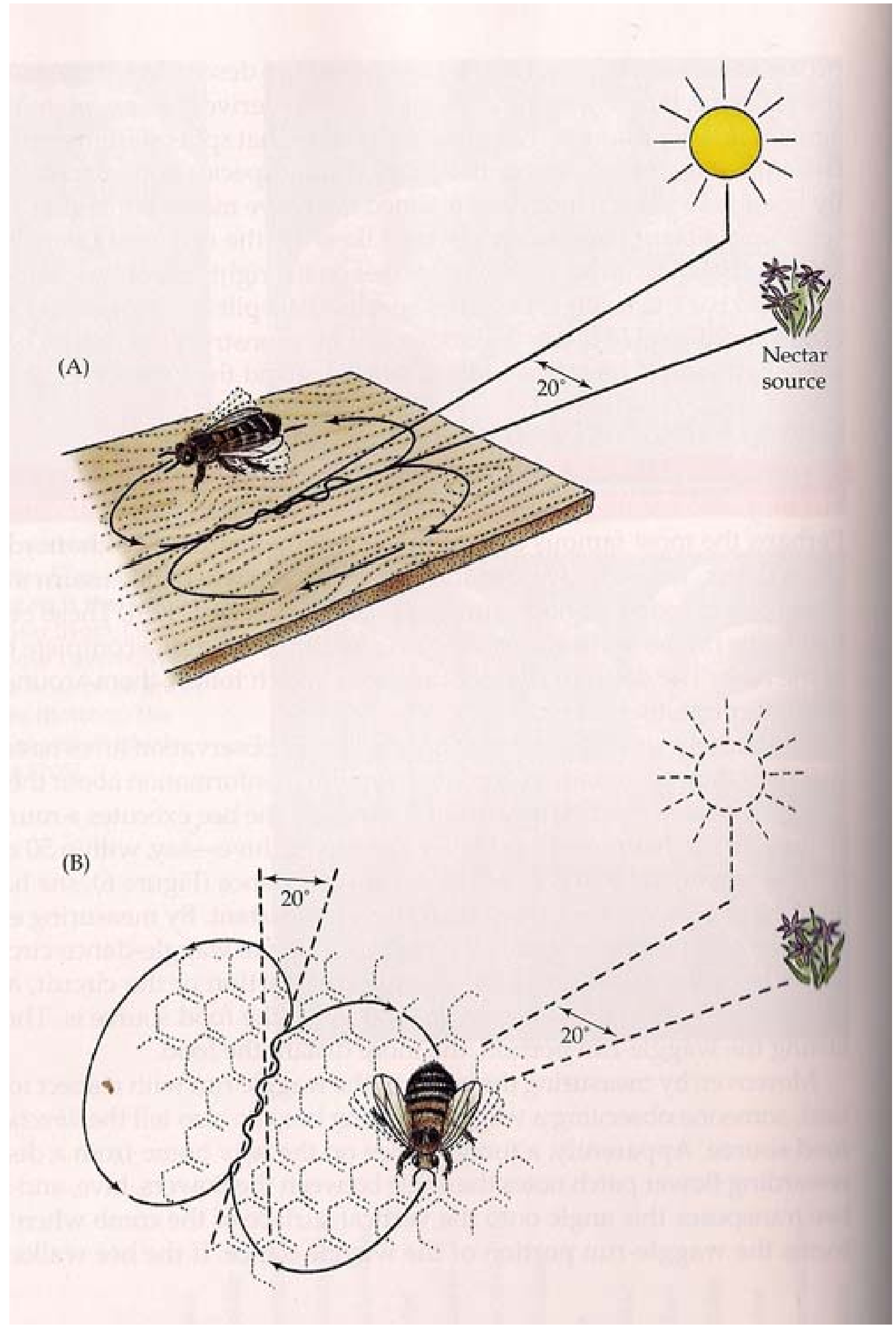
2. Waggle dance

food source is >50 meters

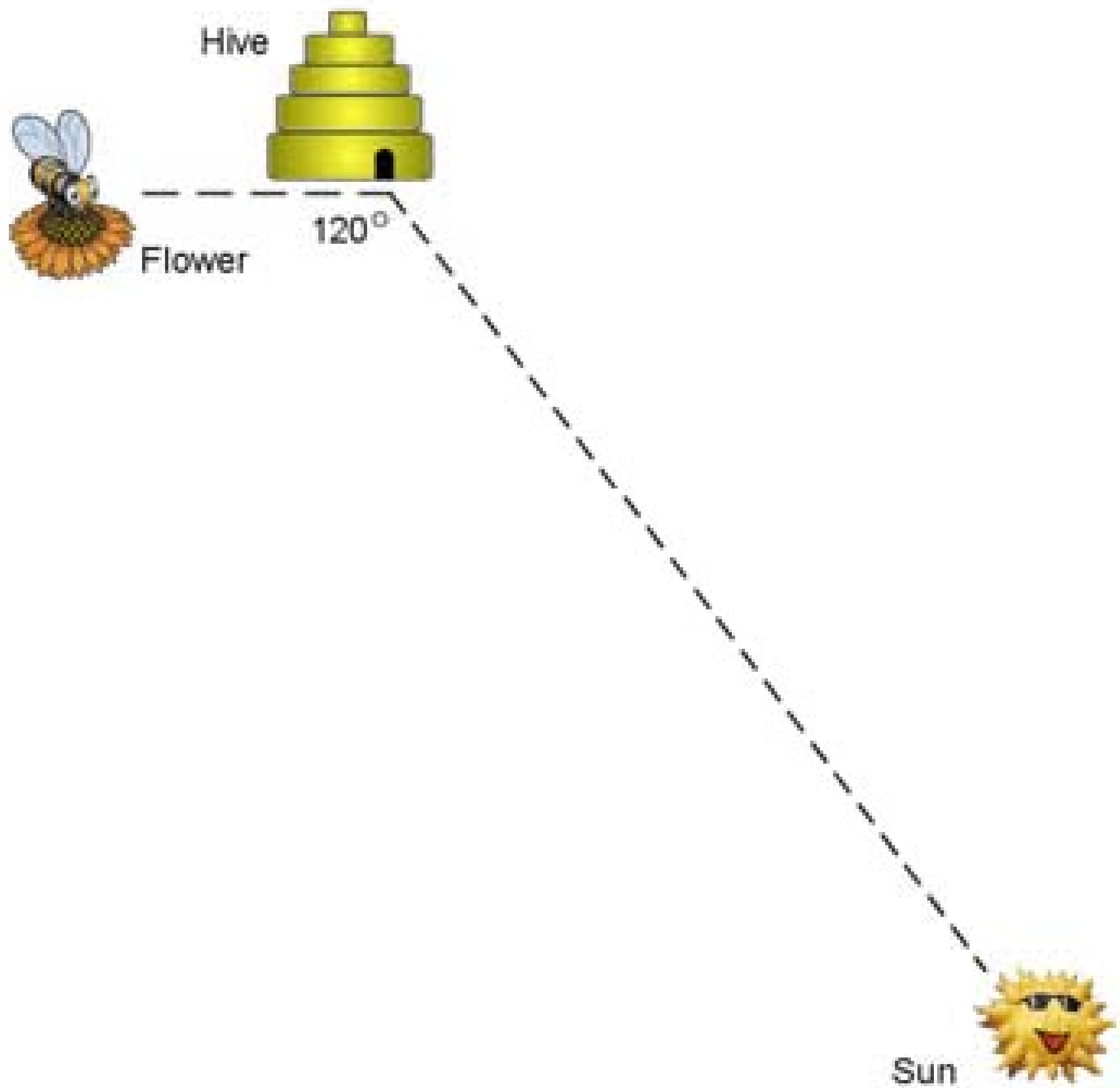
3. Angle of the dance:

direction to the food source.

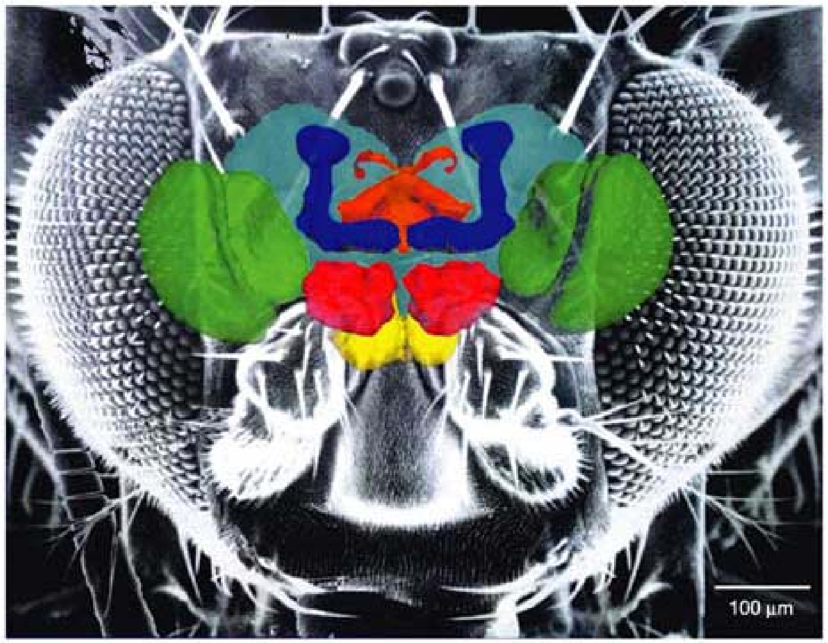




# Waggle dance


Hive
Flower
120°
Sun

# Mushroom bodies and honeybee foraging

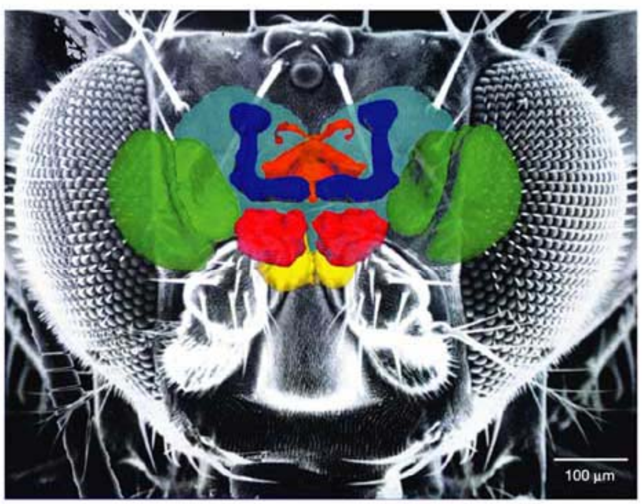



Nature Reviews | Neuroscience

Mushroom bodies – spatial navigation and memory ; its function is similar to the Hippocampus in vertebrates

Forager workers have significantly larger (15%) mushroom bodies than bees that remained in a colony.

# There is a correlation between Mushroom bodies size and honeybee foraging behavior




Nature Reviews | Neuroscience

Can we say Mushroom bodies grow in size causes the foraging behavior?

Or foraging behavior causes the size of Mushroom bodies increases?

How do you conduct an experiment to test the cause-effect?

Experimentally remove the mushroom bodies

Induce the foraging behavior in younger bees

# Molecular mechanisms of honeybee foraging

*Per* gene might be responsible for honeybee foraging

Forager bees have higher mRNA expression of *Per* than those bees remain in the nest.

There is a correlation between *Per* gene expression level and honeybee foraging behavior

Can we say higher *Per* gene expression causes the foraging behavior?

Or foraging behavior causes the higher expression of *Per* gene?

There is a correlation between *Per* gene expression level and honeybee foraging behavior

Can we say higher *Per* gene expression causes the foraging behavior?

Or foraging behavior causes the higher expression of *Per* gene?

How do you conduct an experiment to test the cause-effect?

Experimentally reduce (knock-down) Per gene expression

Induce the foraging behavior in younger bees

# Hormone mechanisms of honeybee foraging

*Juvenile hormone (JH)* is
responsible for honeybee foraging

As bees mature into foragers that leave the nest,
the level of JH significantly increases.

There is a correlation between *JH* hormone level and honeybee foraging behavior

Can we say higher *JH* hormone level causes the foraging behavior?

Or foraging behavior causes the higher level of juvenile hormone?

How do you conduct an experiment to test the cause-effect?

Experimentally remove the gland that produces *JH.*

Induce the foraging behavior in younger bees